

# Sub-seasonal prediction at ECMWF

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- *Description of the forecasting system and evolution of skill scores*
- *Future model changes*
  - *Re-forecast extension*
  - *Increased atmospheric resolution*
  - *Extension to 46 days*
  - *Sea-ice – NEMO 1.4 degree*
- *International Collaborations*

# The operational ensemble in 2015

ENS includes 51 forecasts with resolution:

- T<sub>L</sub>639L91 (~32km, 91 levels, top at 0.01 hPa) from day 0 to 10
- T<sub>L</sub>319L91 (~64km, 91 levels, top at 0.01 hPa) from day 10 to 15 (32 at 00UTC on Mon + Thurs).

## • Atmosphere

Initial uncertainties T42L91 SVs+ T399L137 EDA perturbations

Model uncertainties Stochastic physics (SPPT and SKEB schemes).

The central analysis is the T<sub>L</sub>1279L137 4DVAR.

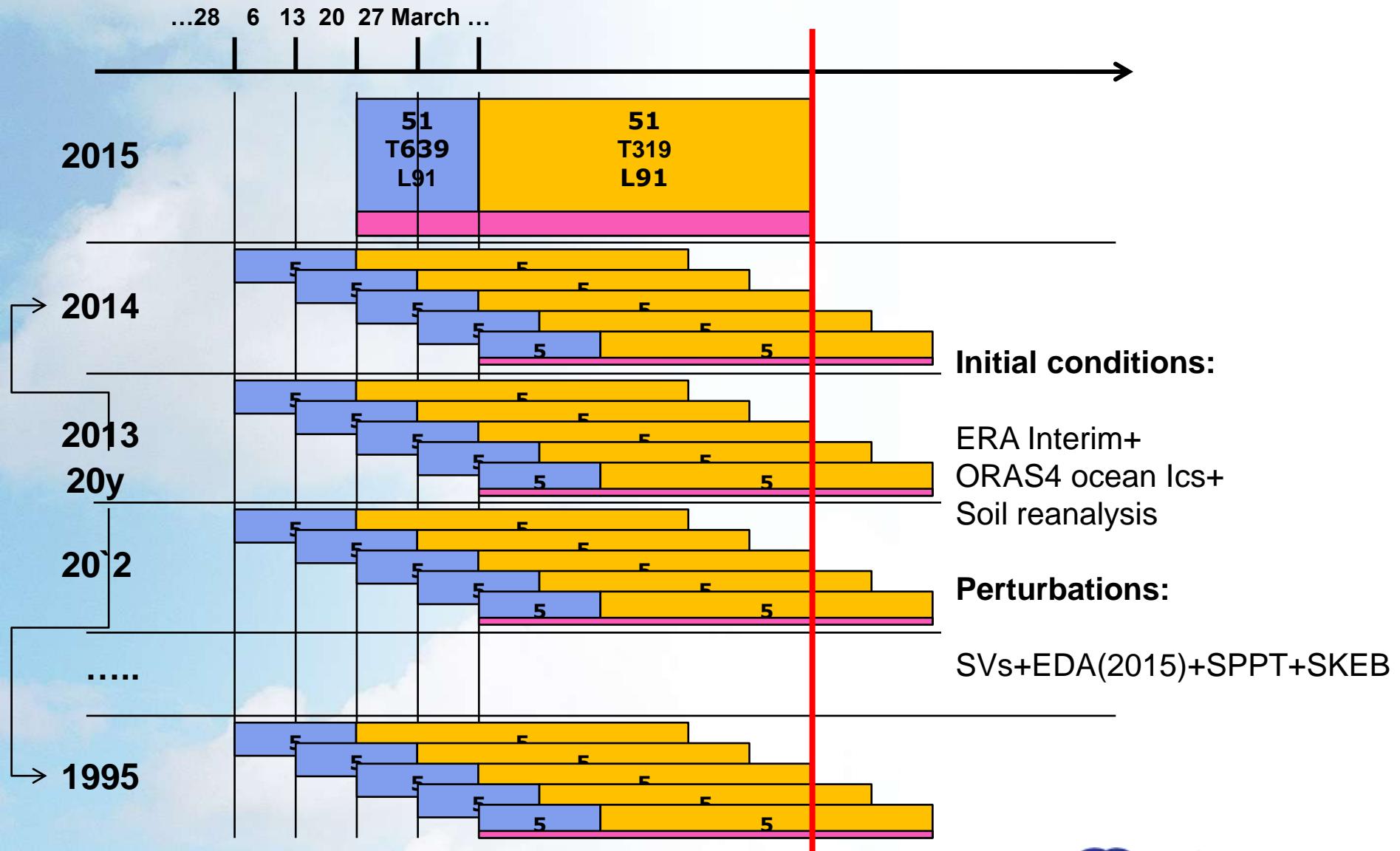
coupled to wave model (WAM) every time step

## • Ocean

NEMO (about 1 degree resolution) coupled to IFS and WAM every 3 hours.

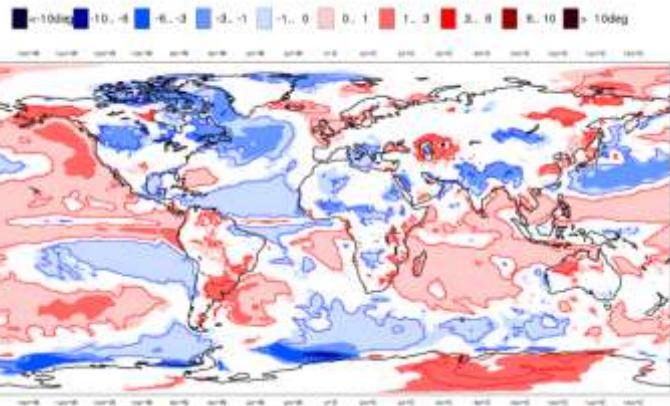
Ocean initial conditions provided by 5-member NEMOVAR analysis

# The ENS re-forecast suite to estimate the M-climate

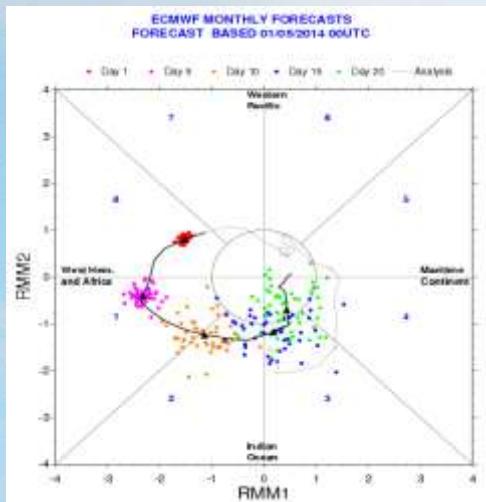


# ECMWF Extended-range forecast products

## Forecast Anomaly



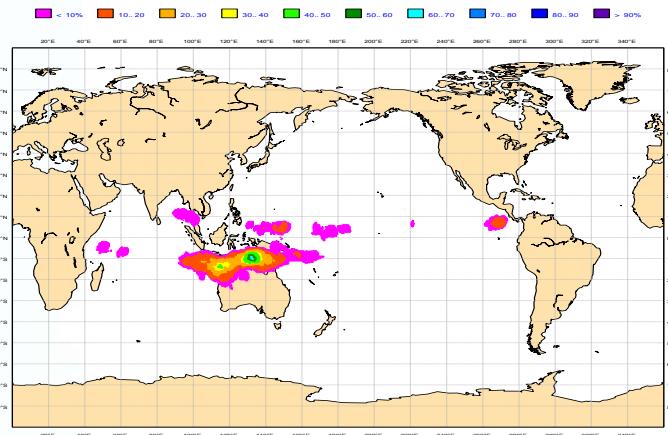
MJO



## Tropical Cyclone activity

Weekly Mean Tropical Cyclone Strike Probability. Date: 20100408 0 UTC t+(264-432)

Probability of a TC passing within 300km radius

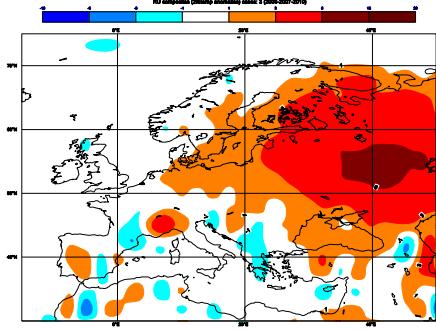
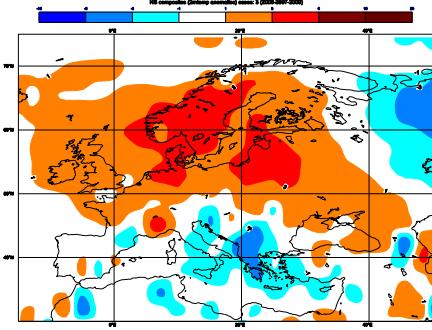
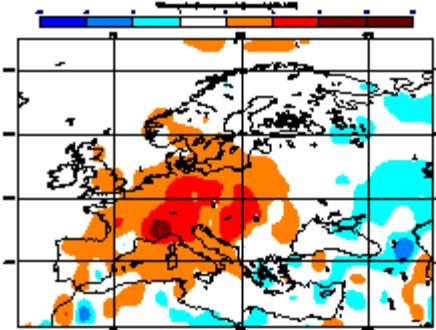
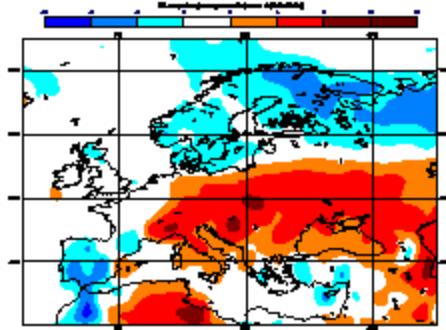


Also:

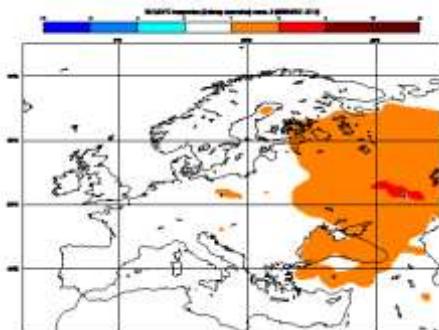
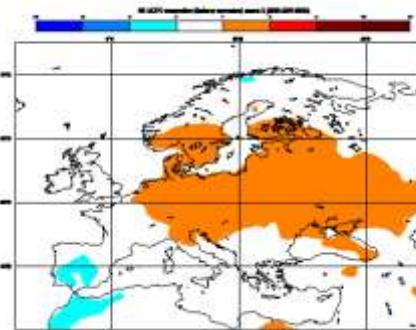
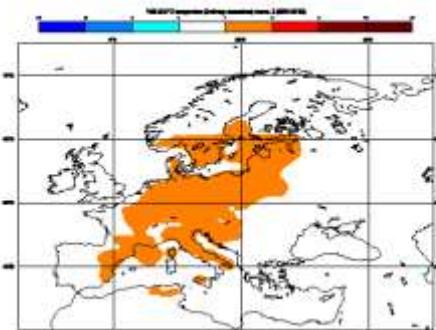
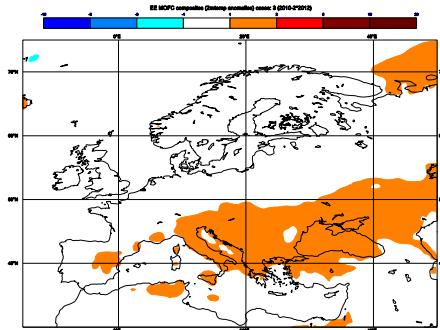
- Weather regime probabilities
- Tercile maps, probability maps
- Extreme Forecast Index

# Heat Wave Prediction

## ERA Interim

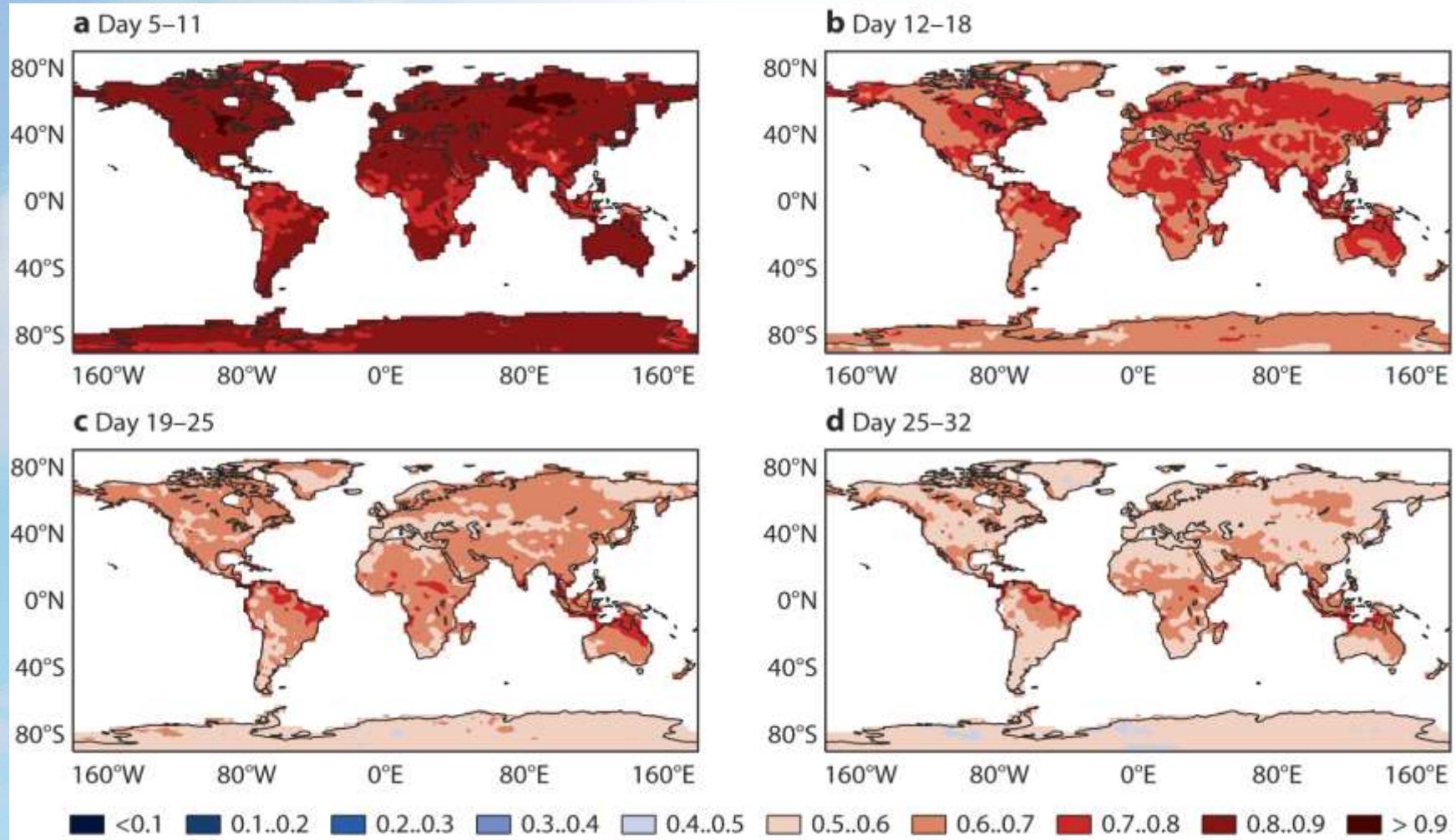


## Monthly Forecast Day 12-18



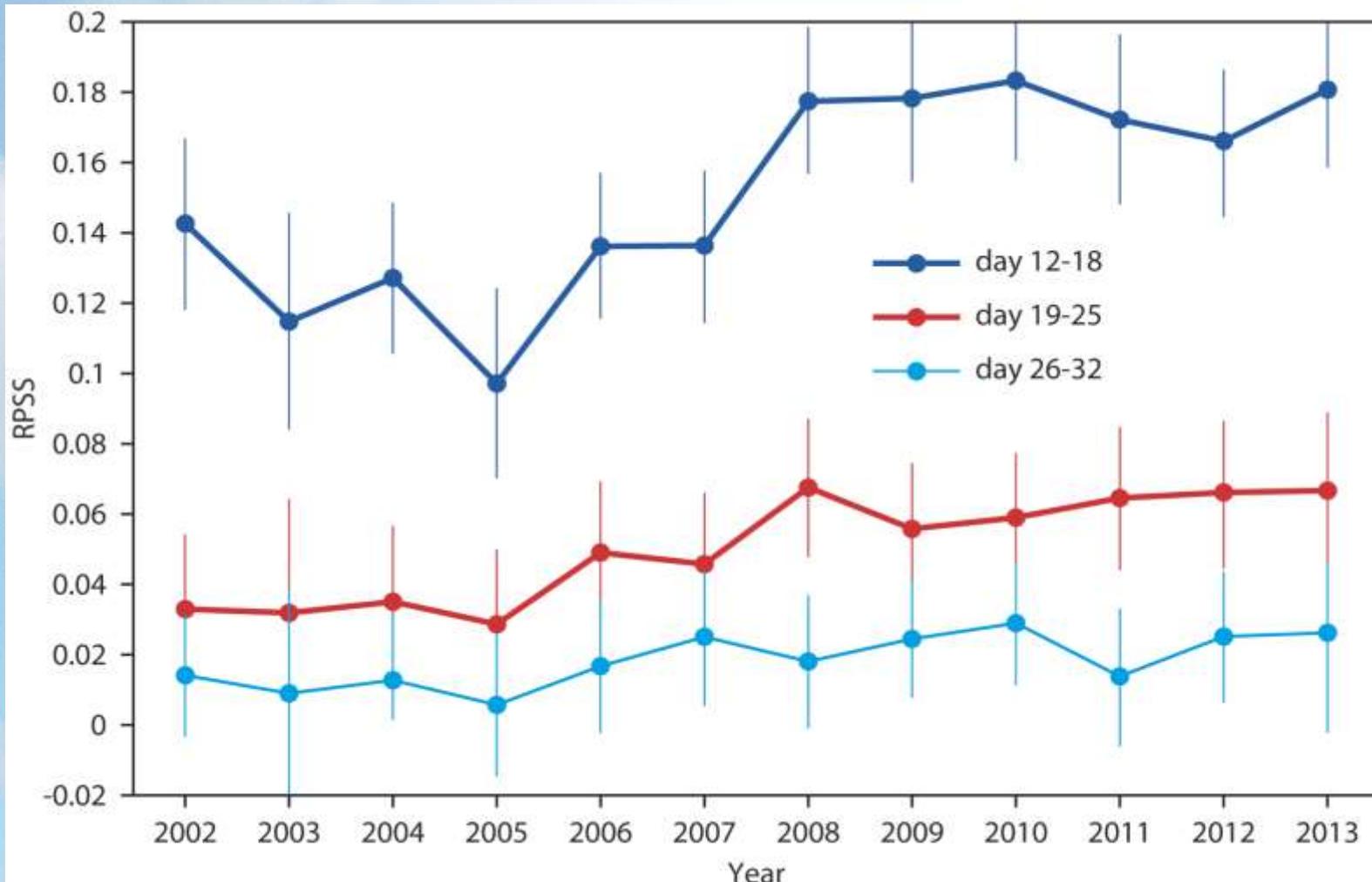
# Monthly Forecast Skill scores

*ROC area – Probability of 2mtm in upper tercile*



# Monthly Forecast Skill scores

RPSS— Probability of 2mtm in upper tercile  
NDJFM

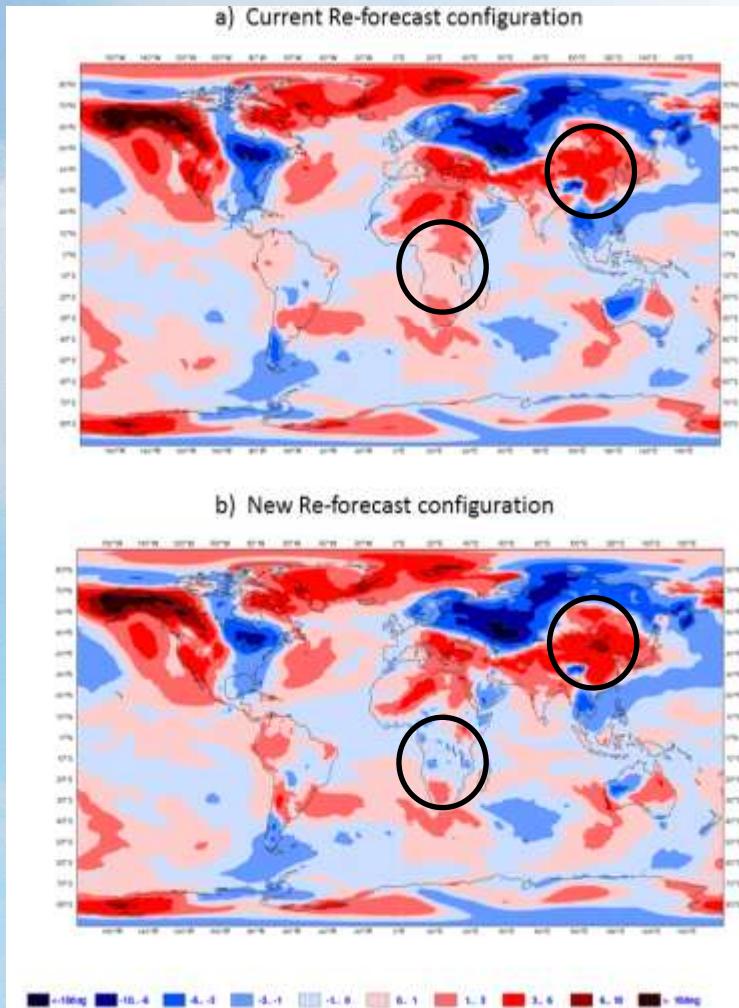


# Index

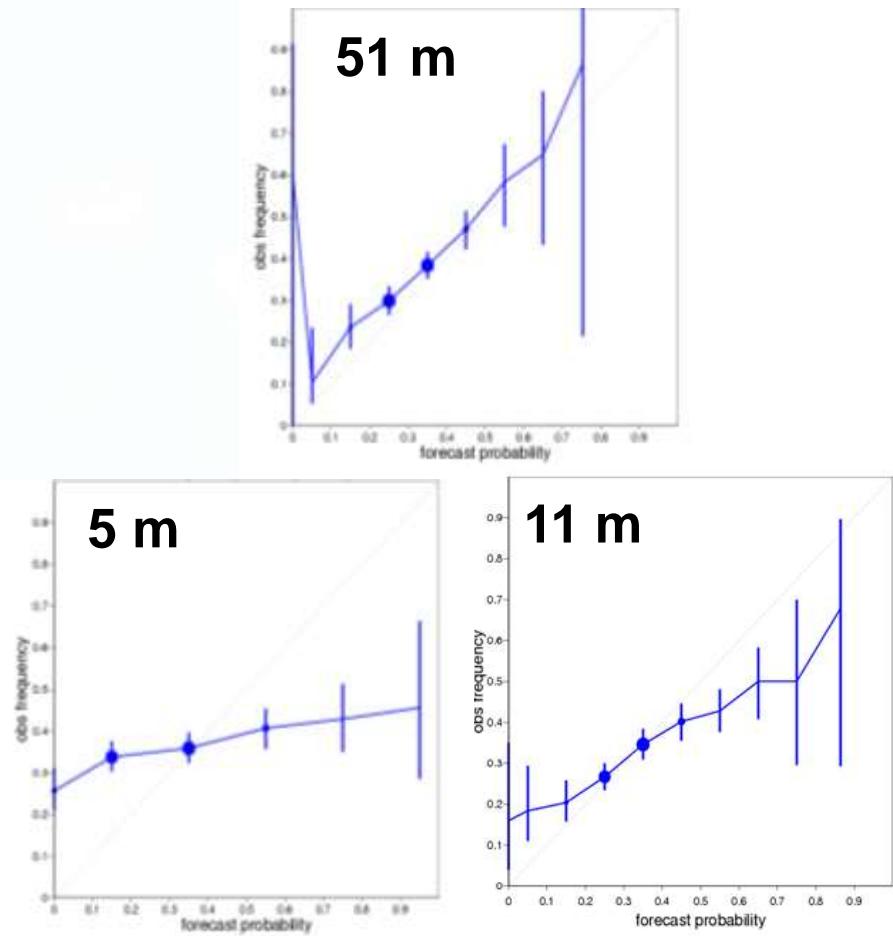
- *Description of the forecasting system and evolution of skill scores*
- ***Future model changes***
  - *Re-forecast extension (May 2015)*
  - *Increased atmospheric resolution (2016)*
  - *Extension to 46 days (May 2015)*
  - *Sea-ice – NEMO  $\frac{1}{4}$  degree (2016)*
- *International Collaborations*

# Extend the re-fc ensemble to twice a week, 11 members

## Impact on calibration 2mtm anomalies – Day 26-32



## Impact on verification T850- Upper terciles – Week 4





# Increased atm. horizontal resolution

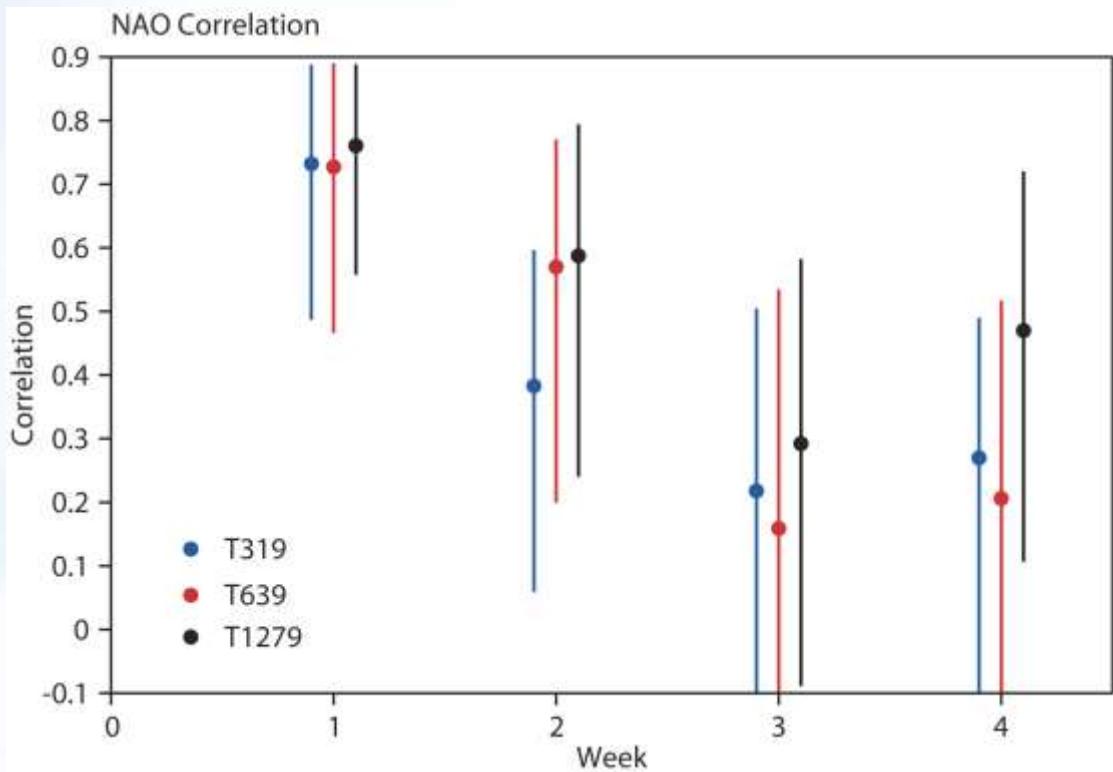
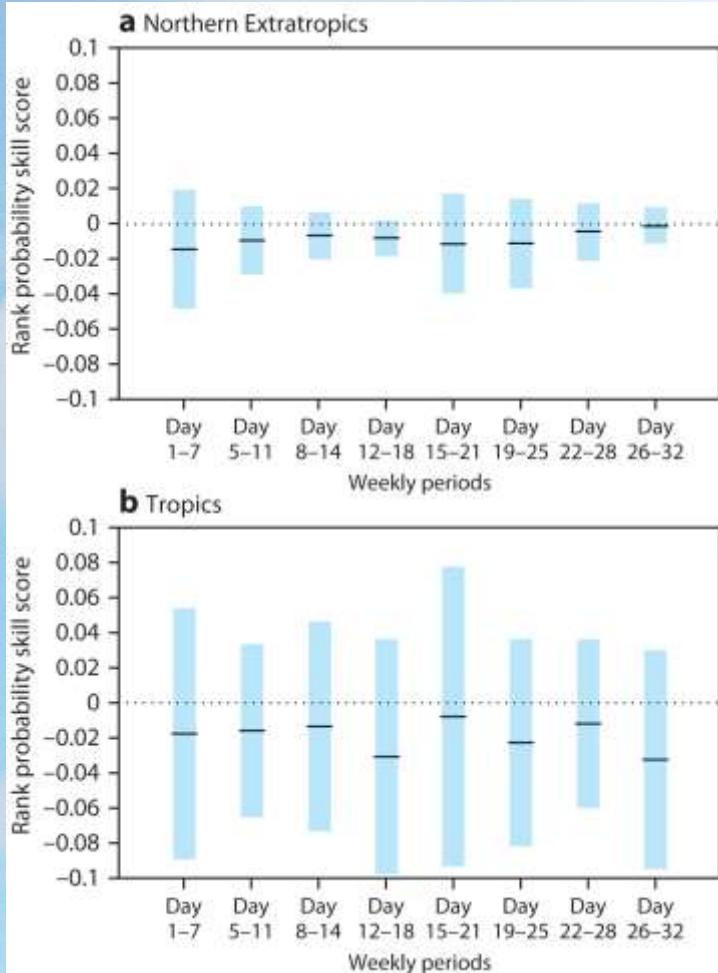
## Minerva Prediction Experiments (COLA/ECMWF/NCAR)

Experiment	Years	Ens. Size	Initial Months	Duration (mon)
T319_base	1980-2011	51	May, Nov	7
T319_2_year_extension	1980-2011	15	May	24
T639_base	1980-2011	15	May, Nov	7
T639_extended_ensemble	1980-2011	36	May, Nov	May: 5 mo Nov: 4 mo
T639_2_year_extension	1980-2011	15	Nov	24
T1279_base	2000-2011	15	May	7
<b>T1279_ext</b>	<b>1980-2011</b>	<b>15</b>	<b>May, Nov</b>	<b>7</b>

# Increased atmospheric horizontal resolution

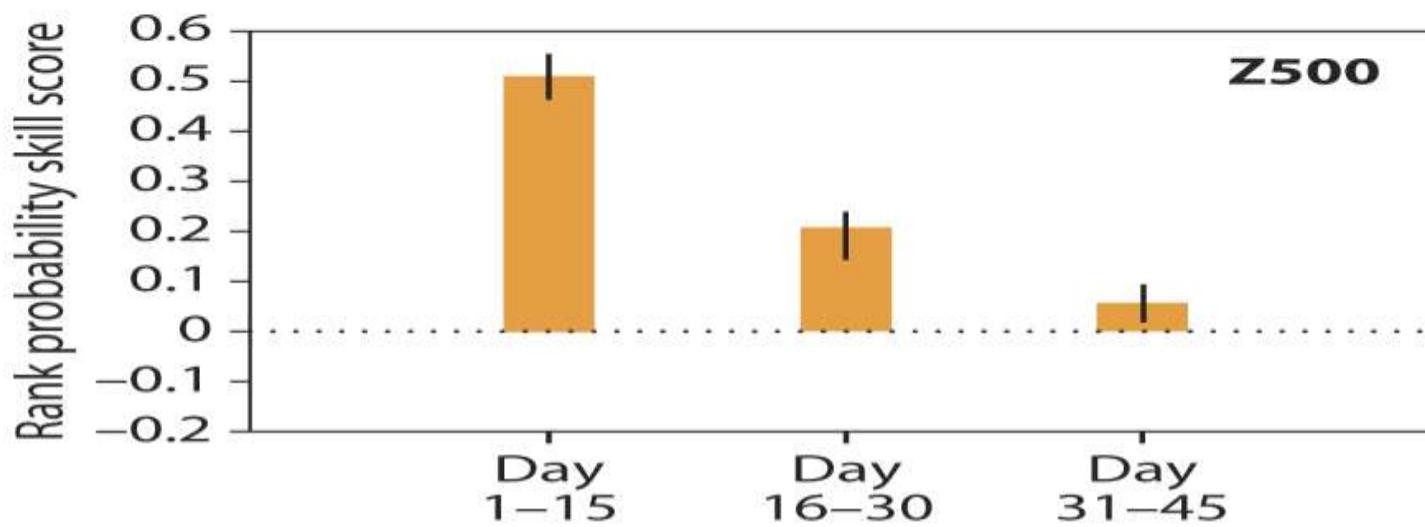
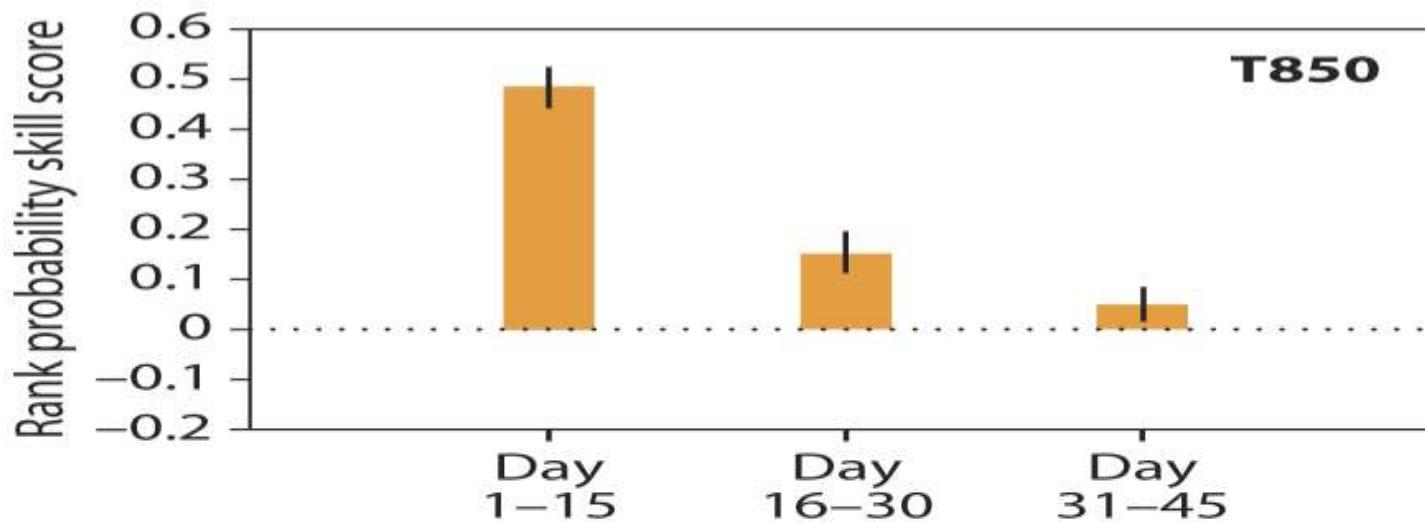
## Impact on skill scores

Precipitation  
RPSS T319 - T639



# Extension to 45 days

## Europe

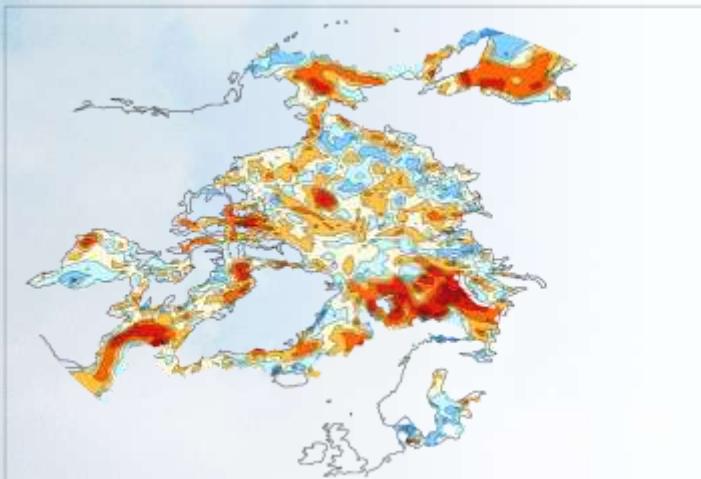


80 case, starting on 1<sup>st</sup> Feb/May/Aug/Nov 1989-2008

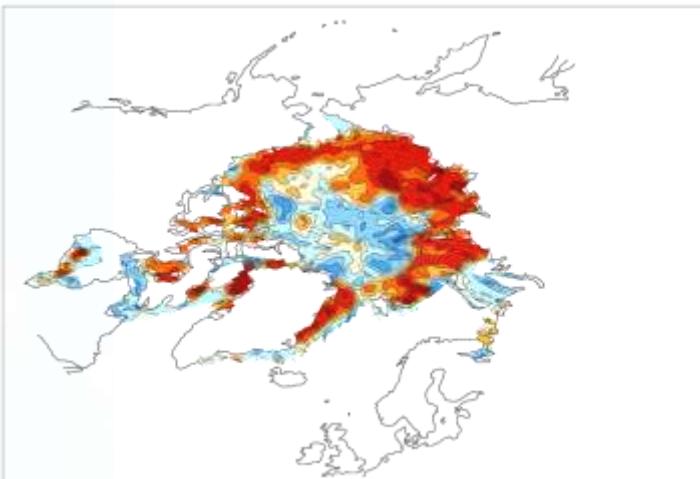
# Correlations for week 4 Northern Hemisphere

Current system

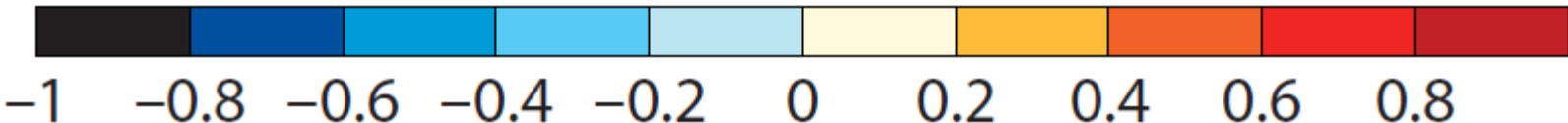
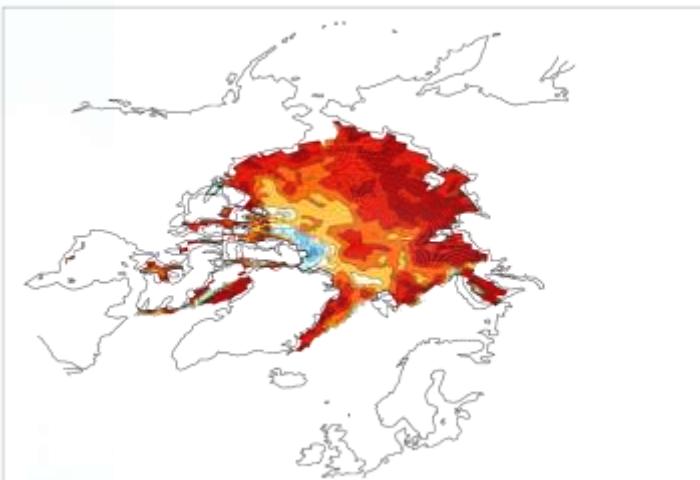
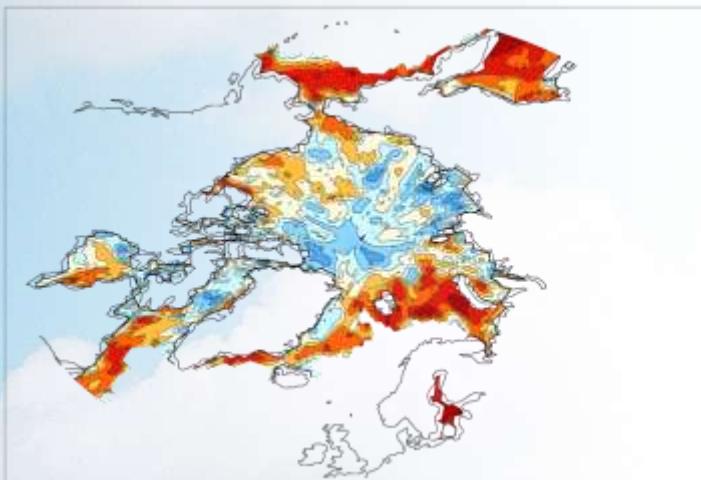
Winter



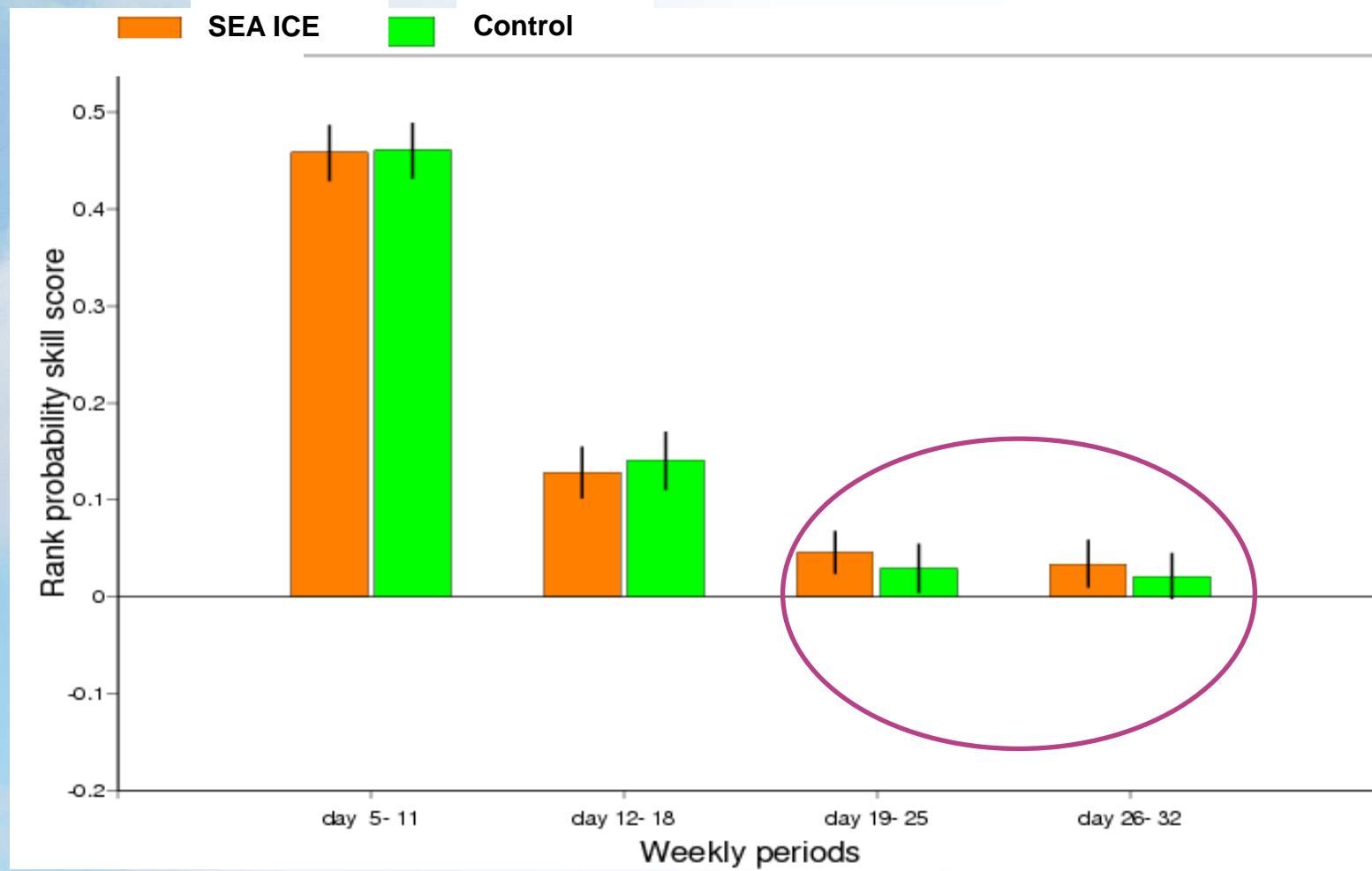
Summer



With sea-  
ice model  
(LIM2)



# Active sea ice model: Z500 Forecast Skill (weeks 1-4)

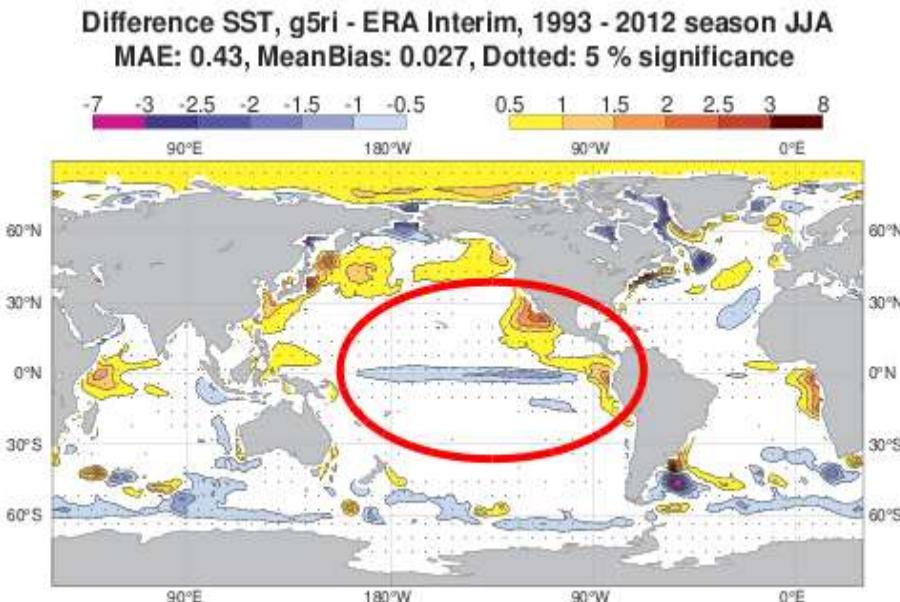


80 cases – The vertical bars represent the 95% level of confidence

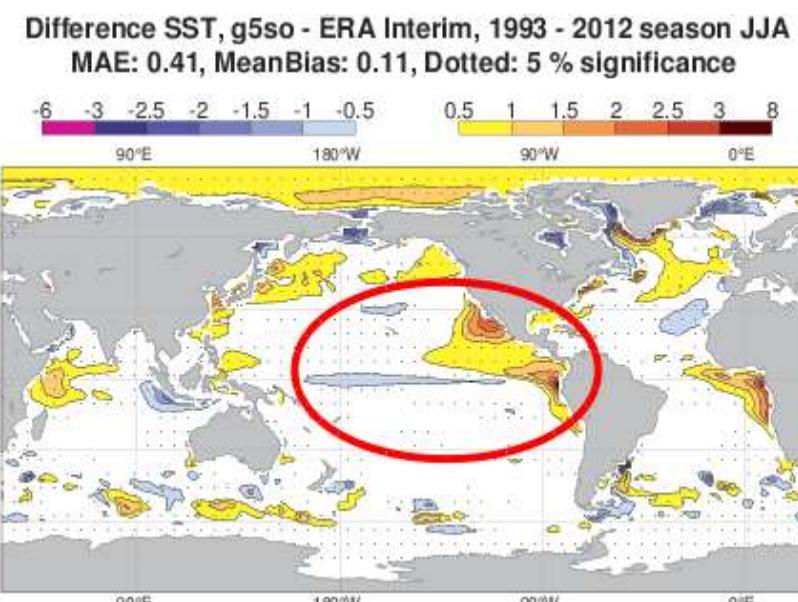
# New Higher-resolution Ocean Reanalysis

The first integrations with the  $\frac{1}{4}$  degree z75 ocean model (NEMO) indicates a general warming of the SST, with a reduction of the cold biases in the tropical Pacific during JJA. Work will continue to investigate the role of mixing, with the goal to define the ORCA025z75 configuration to be implemented in ENS by the end of 2015.

ORCA1z42

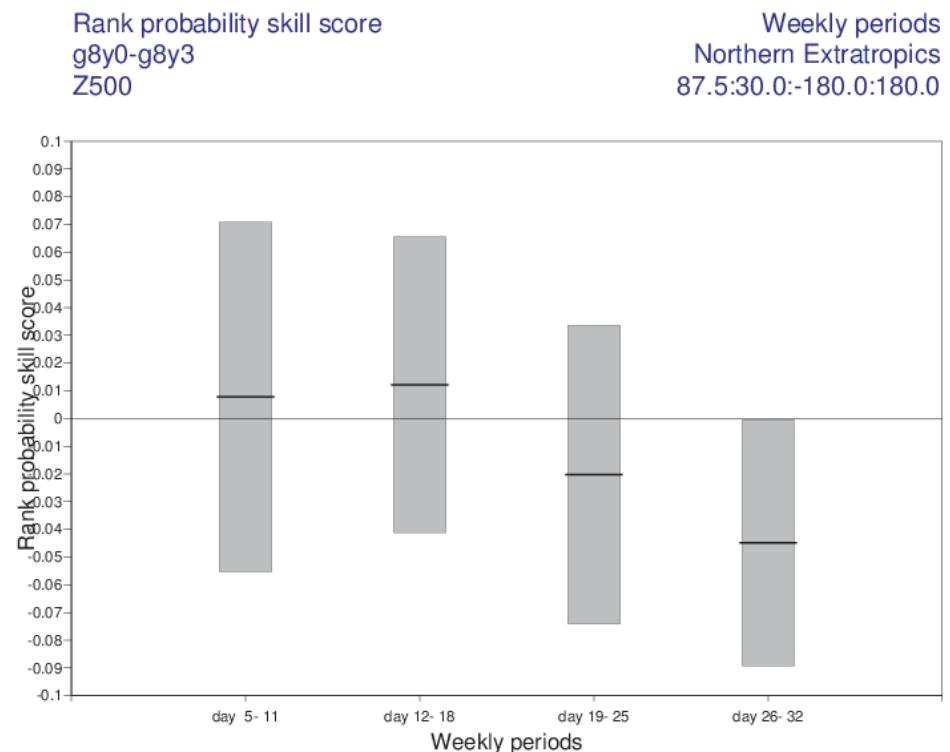
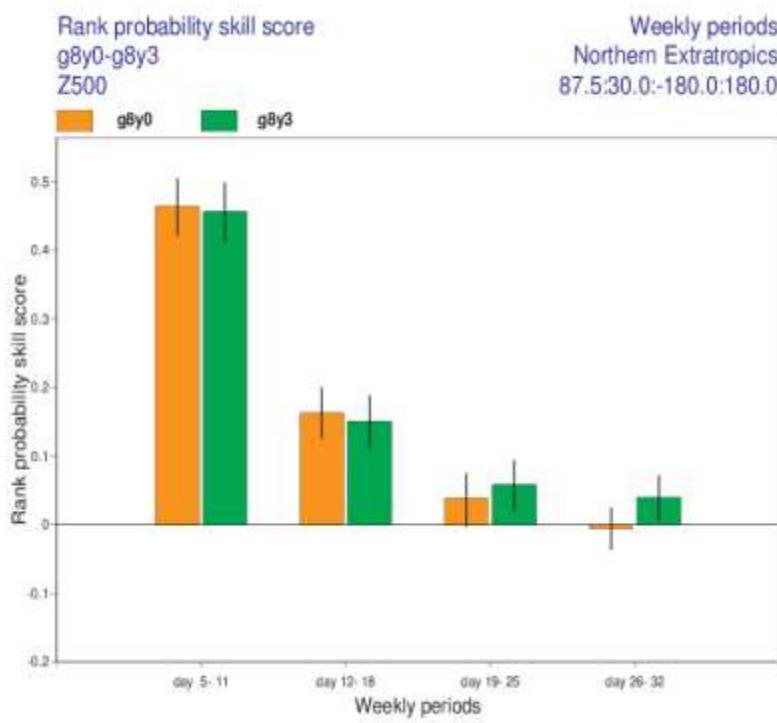


ORCA025z75



# New Higher-resolution Ocean

## 1/4 vs 1 degree – Z500 skill scores -NH



# S2S database

	Time-range	Resol.	Ens. Size	Freq.	Hcsts	Hcst length	Hcst Freq	Hcst Size
<b>ECMWF</b>	D 0-32	T639/319L91	51	2/week	On the fly	Past 20y	weekly	5
<b>UKMO</b>	D 0-60	N216L85	4	daily	On the fly	1996-2009	4/month	3
<b>NCEP</b>	D 0-45	N126L64	4	4/daily	Fix	1999-2010	4/daily	1
<b>EC</b>	D 0-35	0.6x0.6L40	21	weekly	On the fly	Past 15y	weekly	4
<b>CAWCR</b>	D 0-60	T47L17	33	weekly	Fix	1981-2013	6/month	33
<b>JMA</b>	D 0-34	T159L60	50	weekly	Fix	1979-2009	3/month	5
<b>KMA</b>	D 0-60	N216L85	4	daily	On the fly	1996-2009	4/month	3
<b>CMA</b>	D 0-45	T106L40	4	daily	Fix	1992-now	daily	4
<b>Met.Fr</b>	D 0-60	T127L31	51	monthly	Fix	1981-2005	monthly	11
<b>CNR</b>	D 0-32	0.75x0.56 L54	40	weekly	Fix	1981-2010	6/month	1
<b>HMCR</b>	D 0-63	1.1x1.4 L28	20	weekly	Fix	1981-2010	weekly	10